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# IMAGE COMPRESSION USING FOURIER TRANSFORM

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**Abstract**: In this paper we are working on compression with different view. Moto of given paper, create our own compression technique having efficient in term of computability and time complexity. In this technique we have go through Fourier transform and its simple property. In proposed technique work only on the internal spectra i.e high energetic image representing coefficient are used. The main task in compression convolution will totally removed. via view of quality parameter is also important in case of compression that will tally for quality assurance in this paper we have used PSNR, MSE. As compare to conventional technique result are good. To proceed future challenges for save frequency domain as a compressed image.

**Keywords**: DFT, FFT, fftshift.

***PAPER-QR CODE***

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## INTRODUCTION

Compression is a need of information society. We are living in information age here at most all work perform through computer. Human added automated systems will present in new generation. Regarding to atomization the feed of automated system is raw data. The end user can't be aware for data storage and manipulation, but in the case of huge amount of data preservation, storing the huge amount of data at secondary storage can't be possible place as it is. But it is a basic need of computer added system for information or knowledge or intelligent generation. So data storage is an important issue in information survival [1].

Now days the various compression techniques used for image compression in which famous technique is jpeg image compression. Basically through literature image compression divided into two types' i.e. lossy image compression and lossless image compression. whereas Run-length encoding, DPCM and Predictive Coding , Entropy encoding , chain codes, Adaptive dictionary algorithms such as LZW used in GIF and TIFF, Deflation used in PNG, MNG, and TIFF used for lossless image compression and Chroma sub sampling, Transform coding, Fractal compression that method used in lossy image compression[2]. Selection of lossy or lossless image compression is based on the application of the image in medical imaging we can't be apply the lossy image compression because of in medical imaging the little aspect will important, in technical drawing also the small thing have a meaning. But in case of entertainment or natural image such as photographs in which no more effect of pixel rate only Moto of picture is human understandable.

We are going for image compression through transformation coding. There are various transformation techniques available in which discrete Fourier transform, discrete cosine transform and wavelets transform. The already used transform are complex for execution and time consuming. To solve this problem Fourier transform is used. The Fourier transform is an important image processing tool which is used to decompose in image into its sine and cosine components [3]. DFT is also use for filtering and enhancement of image.

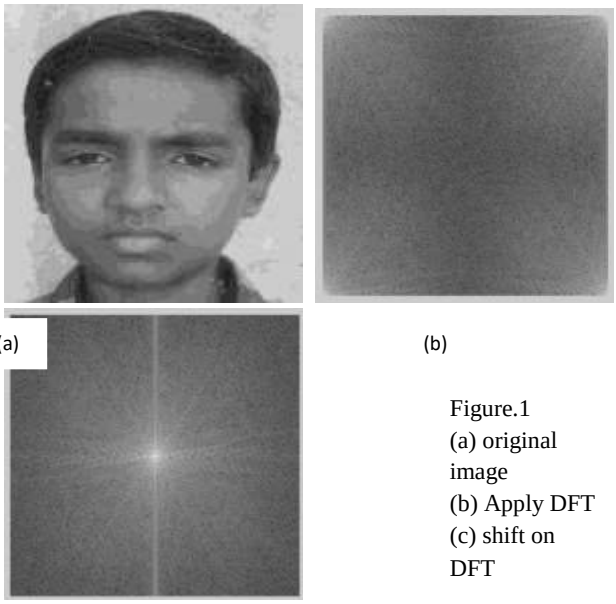
## I. TRANSFORM

When the concept of transform is occurred then there will be two domains input domain and output domain. Discrete Fourier transform is used for the decomposing the image. That convert image space domain to frequency domain. In watermarking DFT is used. The advanced version of DFT is fft i.e fast Fourier transform. Basic difference between DFT and fft, some numerical term will reduces for increasing time efficiency and reduce execution complexity [3]. Fourier transform offer the various properties like symmetry, Correlation, Convolution, Time Derivative , Complex Conjugation, Time and frequency scaling , Even and Odd Signals and Spectra, Frequency shift .

$$A_{yx}(y) = \int_{-\infty}^{\infty} a(x) e^{-2\pi yx}\, dx \quad (A)$$

$$a(x) = \int_{-\infty}^{\infty} A_{yx}(y) e^{-2\pi yx}\, dy \quad (B)$$

Equation (A) shows the mathematical calculation of Fourier transform, in which $A_{yx}(y)$ shows the global signal distribution of signal a(x). Applying DFT then the high energetic value will concentrate or concur at corner of the image i.e for analysis of spectral domain the DFT is used. For implementing Fourier transform number of algorithm will be available in which fast Fourier transform (FFT) is efficient algorithm for calculating DFT. It is fast and efficient way of calculating DFT, which reduces number of arithmetical computations from $0(N)^2$ to $0(N\log_2 N)$ [6].



(a) (b)

(c)

Figure.1
(a) original image
(b) Apply DFT
(c) shift on DFT

Fast Fourier transform also known as spectral involves or frequency analysis which is implemented or used in the image processing and signal processing [3]. FFT perform high efficiency and completeness of DFT. In MATLAB fft2 function is used for fast Fourier transform. Following equation (C) and (D) shows the computational efficiency of fft2 and ifft2 i.e DFT and IDFT.

$$H(u,v) = \frac{1}{mn}\sum_{x=0}^{m}\sum_{y=0}^{n} h(x,y)\, e^{-j2\pi\left(\frac{ux}{m}+\frac{vy}{n}\right)} \quad \text{(C)}$$

$$h(x,y) = \sum_{x=0}^{m}\sum_{y=0}^{n} H(u,v)\, e^{j2\pi\left(\frac{ux}{m}+\frac{vy}{n}\right)} \quad \text{(D)}$$

When apply the fast Fourier transform on the gray scale image then the digital image get converted in to frequency domain and high energetic value concentrate on the corner having same dimension image. That image in frequency domain but the characteristic of image will same i.e value remain same in complex format having real and imaginary part.

## II. IMAGE COMPRESSION USING FOURIER TRANSFORMS

In proposed technique take a gray scale image having 256 X 256 pixel value. Apply the Fourier transform on that image. In this paper we are trying to simulation for image compression using Fourier transform. When apply the transform then quantization process will perform, process continuous range of value in finite range this important part of image compression. In this technique apply fft2 on whole image because of we take 2D image and

apply shift property on that image. After applying fftshift the high energetic value gathered at the center of image.

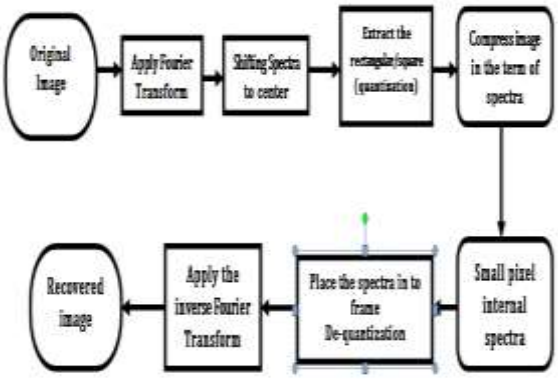



**Figure 2. Image compression and recovery**

Extract that high energetic coefficient i.e quantization process on that image and save the image in form of that coefficient. Next task is image recovery for image recovery we have use de-quantization process in which saved coefficient place at centered fill other value with one. Apply the inverse Fourier transform i.e ifft2 that image and image will recovered with same dimension. The detail proposed scheme as shown in fig.2.

## III. EXPERIMENTAL WORK

For achieving efficiency of method we have perform various experiment on the proposed method. Four cases are used for analyzing coefficient efficiency which is selected from spectra. We have taken four different dimensional samples i.e 150X150, 100 X100, 50X50 and 20X20. Evaluate the recovered image by using quality parameter, image compression performance parameter like PSNR, MSE and CR. Following parameter are used for evaluating the performance and image quality.

Compression Ratio (CR):-

$$CR = \left(\frac{\text{Orignal image size} - \text{Reconstructed image size}}{\text{Orignal image size}}\right) \times 100$$

Mean Square Error (MSE):-

$$MSE = \frac{1}{m,n}\sum\sum(X_{i,j} - Y_{i,j})^2$$

Pike Signal Noise Ratio(PSNR):-

$$PSNR = 20 * \log_{10}\left(\frac{255^2}{MSE}\right)$$

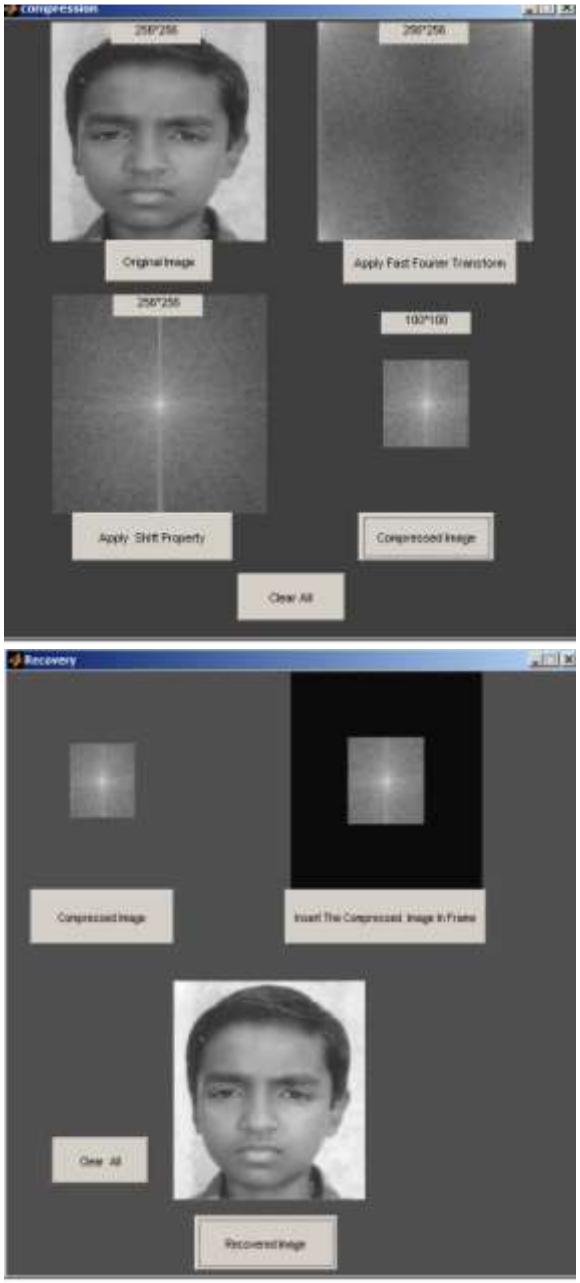
In compression ratio original image size shows the dimensional representation of image i.e 256X256=65536 and reconstructed image size means coefficient which is save for image recovery for Ex.100X100=10000coifficient. In case of MSE Where X is original image, Y is the approximation of decompressed image and m , n are dimensions of the image[3].

| Original image | compressed image dimension | Recovered Image | CR | PSNR | MSE |
|---|---|---|---|---|---|
|  |  150X150 |  | 65.66 | 61.808dB | 0.04 |
| |  100X100 |  | 84.74 | 54.219dB | 0.25 |
| |  50X50 |  | 96.18 | 48.981dB | 0.83 |
| |  20 X 20 dimension |  | 99.39 | 44.049dB | 2.58 |

## IV. RESULT AND DISCUSSION

Results are depending on the internal spectra use for compression. We have mention above aspect in image compression. Following table shows the result for compression technique with compression ratio, peak signal noise ratio and mean square error.

***GUI for Implementing Propose Technique***




**CONCLUSION**

In this simulation we have concluded, when we apply DFT for image compression then compression ratio depends on to the selection of spectra. In this experiment we have used four cases in first case image recovered as well as enhance, second case 100x100 spectra will used then the image recovered better. Basically DFT use for image enhancement then at that sense of image recovery image recover as well as enhance and full fill the all quality parameter. In

third case is average case, in this case image recover low quality but compression ratio grow up to 96.18 %. in forth case having some artifacts due to less coefficient selection. If we compare compression ratio with PSNR value then we observed that high PSNR rates to low compression ratio, High compression ratio also defect on the MSE and SNR value. In the all aspect of computation and complexity the Fourier transform superior as compare to other technique. The main part in image compression i.e convolution is totally removed from given technique due to this time complexity also reduces. Only challenging task for image compression how to store those spectra at actual memory location? In MATLAB this is easy task but at actual time of memory allocation this thing being critical. At another way we have use the only real part or imaginary part as a compressed image. For future work we have also use DFT property i.e conjugated symmetry by applying this property compression ratio also increases up to fifty percent.

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